

Assignment-2- Solution

①

Given

$$m = 700 \text{ kg}$$

$$S = 12.472$$

$$V_\infty = 40 \text{ m/s}$$

$$C_{L_{min}} = ?$$

Using

$$L = W = \frac{1}{2} \rho V^2 S C_L$$

$$700 \times 9.81 = \frac{1}{2} \times 1.2256 \times (40)^2 \times 12.47 \times C_L$$

$$C_L = 0.56144$$

$$\boxed{C_{L_{min}} = 0.56144}$$

②

$$C_{m\alpha} = C_{La} [\bar{x} - \bar{x}_{ac}]$$

$$= C_{La} \left[\frac{1}{4} - \frac{1}{4} \right]$$

$$\bar{x} = \frac{1}{4}$$

$$\bar{x}_{ac} = \frac{1}{4}$$

$$\boxed{C_{m\alpha} = 0}$$

③

for symmetrical airfoil the mean camber line coincide with chord line. So the distance between them always will be Zero.

④

At aerodynamic centre

$$\boxed{\frac{dC_m}{d\alpha} = 0}$$

So the

pitching moment coefficient is independent of angle of attack.

⑤ Given

$$C_m = -0.15 + 0.0315\alpha$$

at trim condition -

$$C_m = 0$$

$$0 = -0.15 + 0.0315 \alpha_{trim}$$

$$\alpha_{trim} = \frac{0.15}{0.0315}$$

$$\alpha_{trim} = 4.7619^\circ$$

⑥ By increasing or decreasing the free stream velocity the Aerodynamic Centre will not change. So in this case the difference between the location of Aerodynamic Centre in both cases will be zero.

⑦ Given \Rightarrow $AR = 10$
 $S = 10 \Rightarrow AR = \frac{b^2}{S} \Rightarrow b = \sqrt{AR \times S}$
 $= \sqrt{10 \times 10}$
 $b = 10m$

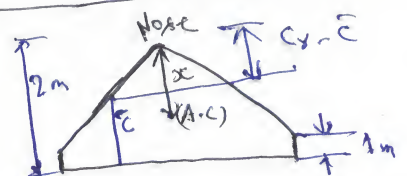
$$\Rightarrow AR = \frac{b}{\bar{c}}$$

$$\bar{c} = \frac{b}{AR} = \frac{10}{10}$$

$$\bar{c} = 1$$

for rectangular wing $C_x = C_L = \bar{c}$ \rightarrow mean aerodynamic chord

⑧ Given \Rightarrow $d = C_L / C_D = 0.5 \rightarrow C_D$
 $C_D = 1m$, from $C_D \Rightarrow C_D = \frac{1}{0.5} = 2m$



$$\bar{c} = \frac{2}{3} C_D \left[\frac{1 + d + d^2}{1 + d} \right] = \frac{2}{3} \times 2 \left[\frac{1 + 0.5 + 0.5^2}{1 + 0.5} \right] \Rightarrow \bar{c} = 1.5555m$$

Nexty $C_x - \bar{c} = 2 - 1.5555 = 0.4444m \Rightarrow$ The distance between A.C and Nose $x = C_x - \bar{c} + \bar{c} = 0.4444 + 1.5555$
 $\frac{1}{4} x = 0.8333$